

which we have selected those for December, January, and February. Thus, from 4th to the 13th of December, 1903, we find warm air near the ground, and cold air, namely, -10° C. to -16° C., at 4 or 5 kilometers. The latter sinks by gravity and is driven by centrifugal force southward over Berlin; colder air takes its place, and by the 18th of December the temperatures of -10° C. and -16° C. are at 3 kilometers above sea level, while on the 20th they are at 2 kilometers above. This rapid descent can not long be maintained. The lower, warmer air must be pushed aside, and that is a very slow process. A rather rapid descent becomes converted into a very much slower horizontal movement. But a rapid motion southward can go on for several days. The air is pushed out from within the areas of high pressure by the weight of the superincumbent mass. It is pushed southward by the excess of the centrifugal force of cold air over warm air. The warming due to the compression that attends the descent of air is now counteracted by the cooling due to radiation as the air flows southward and very slowly, so that there follows the great cold wave of December 23–31.

While the lower air, pressing against the ground, is forced to move horizontally during December 14–25, the upper air, coming down upon it, and unimpeded in its horizontal motion by the ground or mountains, experiences the warmth due to compression and gives rise to the high temperatures of December 18, 21–23, and 24, 25, at altitudes between 1000 and 2000 meters. The observer who ascends in the balloon records these as inversions of temperature, whereas the complex physical process that forms them consists in the cooling of the lower layer as it moves slowly and horizontally, but in the warming of the upper layer as it descends rapidly to the 1-kilometer level.

The diagrams for the months of September and October show that the air above Berlin is at that season liable to very remarkable changes of vertical gradient. Thus, the temperature of 0° C. was found at about 5500 meters on September 2, but at 1100 meters on September 12. This was undoubtedly due to the southward advance of a mass of cold air, which at first piled up the warm air of Europe in front of it to the maximum height shown by the observation of September 3, and then rapidly replaced this by the cold of December 12. But these great changes in the upper atmosphere seem to have had but slight influence on the temperature at sea level, which ranged from 26° on the 2d to 12° on the 11th and 12th.

We, at the bottom of the atmosphere, are as unconscious of the commotion above us as are the animals at the bottom of the ocean.—C. A.

AURORAS AND THUNDERSTORMS.

We have, on many occasions, called attention to the fact that auroral phenomena are often of a local character, as may be inferred from the fact that they are seen from but few stations, although in the neighborhood of many stations reporting thunderstorms, as though the electric discharge forming the aurora is in some way connected with the thunderstorm. On the other hand, we have many extensive auroras that have no apparent connection with local thunderstorms, although they may be associated with the numerous thunderstorms that prevail in the equatorial regions. We suppose that all auroras originate in disturbances of the earth's electric condition, and that such disturbances may be caused either by local atmospheric phenomena or by solar phenomena. In both cases we have earth currents and either lightning or aurora, or both. In both cases, also, we have magnetic disturbances, but these are very slight during the ordinary thunderstorms. It is barely possible that all these phenomena are essentially terrestrial and due to so-called tidal strains or elastic strains in the interior of the globe. Such strains are known to exist and must be as periodic as the tides. They must also have great

irregularities due to the sudden relief of strain that takes place during the geologic process of faulting. It is also possible that influences emanate from the sun that may affect the distribution of electricity in the earth's atmosphere. Both solar and terrestrial causes may therefore produce both the local and the general auroras, and it is not at present possible to state which of these is most important, either in any special case or in general. The fact that there is a maximum frequency of auroras in the early evening of local time, between 8 and 10 p. m., over the whole globe shows that the local or terrestrial influences are quite appreciable. The other fact, that a sudden increase in auroras, earth currents, and thunderstorms occurs on the same day over a large region, such as Europe, the Atlantic, and North America, must be due to either one of two causes; either this represents an influence emanating from the sun and affecting a large part of the earth, or it represents a very important widespread terrestrial influence.

METEOROLOGY IN AUSTRIA.

The annual volume for 1901 of the Central Institution for Meteorology at Vienna is the forty-sixth of the annual series, and is the first published under the auspices of Prof. J. M. Pernter, as director of the institution. In this same year, 1901, the Central Anstalt celebrated the jubilee year of its existence by a festival, the publication of a jubilee volume, and an increase in its funds and work. By way of introduction, Professor Pernter gives a short historical sketch, from which we gather the following facts.

On the 23d of July, 1851, the Emperor Francis Joseph I authorized the establishment of a central institution for meteorology and magnetism, under the directorship of Prof. Karl Kreil, who had previously been director of the observatory at Prague. Carl Fritsch was associated with him as assistant director. The central institution was established at the instigation of the Imperial Academy of Sciences, the first movement thereto having been started May 13, 1848, when the president of the Academy, Baumgartner, stated that for a long time it had been his desire to see the telegraph stations of the railroad lines utilized as meteorological stations. The Academy appointed a meteorological commission to consider the subject, and requested Professor Kreil to prepare instructions for the establishment of a meteorological system of stations for Austria. This date, the 13th of May, 1848, precedes by some months the similar action taken by Prussia, which established a meteorological service under Dove, and also preceded Russia, with its service established in 1849, under Kupfer.¹

For a number of years the central institution occupied small rented rooms or buildings. On December 21, 1862, occurred the death of the first director, and in 1863 Carl Jelinek succeeded him. In 1870 Jelinek secured authority for the erection of a building for the institution. This was located on the Hohe Warte, a hill on the outskirts of Vienna, and was occupied in April, 1872. Here was held the first international meteorological congress in 1873. Jelinek was also the founder of the Austrian system of daily weather telegrams. He began by receiving, in 1865, 14 daily dispatches; in 1869 he began to send out daily forecasts. In 1877 his daily weather report, with synoptic chart, began to be printed. His devotion to meteorology was especially shown by the founding, in 1868, of the Austrian Association for Meteorology, followed by the publication of a monthly journal supported by the society. This journal is now supported by the combined labors of the

¹Americans will recall that Prof. Joseph Henry presented a similar project to the Board of Regents of the Smithsonian Institution, which was immediately adopted, and in the following year Professor Espy was assigned to duty under him. Meteorological observations had, however, been regularly taken and published since 1818 by the Surgeon General of the Army, and since 1817 by the observers of the General Land Office. For fuller details see Weather Bureau Bulletin 11, part 1.